BIOENERGY 2000

"The Bridge to Corn Ethanol"

Buffalo, NY
Tuesday, October 17
8:30-10:00am

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CORN FIBER

1. Why is Williams Bio-Energy, a corn ethanol producer, interested in biomass ethanol?
    - Limitations of corn as a feedstock.
    - Environmental advantages.
    - Improving the bottom line.

2. What is corn fiber?
    - Volumes produced.
    - Current markets.
    - A natural stepping stone to other feedstocks.

3. What are we doing about it?
    - Purdue/DOE project.
    - University of Chicago/DOE project.
    - OSU/USDA project.
    - Other possibilities.

EXPANDING FEEDSTOCK OPTIONS

SLIDE #1

Good morning. I'm Gary Welch with Williams-Pekin Ethanol Facility. I have worked at the Pekin corn wet mill over 33 years - the last 20 years we have made ethanol from corn in Pekin. My job is to develop improved processes and value added products that will optimize the efficiencies of our core business - producing fuel grade ethanol. I'm here today to talk about our interest in biomass as a feedstock for producing ethanol.

Why would a corn processor be interested in biomass as a feedstock? Isn't biomass a threat to the corn to ethanol industry? We at Williams do not see biomass as a threat, but as a necessary step that will complement and provide the opportunity for our industry to grow and become a major force in the total fuel market. There are five specific reasons Williams is interested in biomass to ethanol.

1. Although the American farmer continues to produce increasing levels of agricultural products including corn, there is a limit to how much corn can be produced.
2. Corn also has some geographic limits while biomass, in one form or another, can be found in all geographic areas of the country.
3. With the huge amount of research being done today, biomass conversion technologies may soon offer improved economic advantages.
4. The use of biomass as a feedstock can provide solutions to some of our country's most pressing environmental problems.
5. Improving process efficiencies by increasing co-product value.

SLIDE #2

We're all aware of the environmental problems created by using petroleum based fuels, and of ethanol's role in reducing their effects. The use of biomass can not only increase this role, but can help reduce other environmental problems as well. What to do with undergrowth in our national forests, the burning of rice straw in California, our overflowing landfills and many others. Biomass to ethanol provides a productive, positive solution to many of these environmental problems.

SLIDE #3

Improving the bottom line is what really gets senior management's attention. Getting a few more pennies out of each bushel of corn is one way we can do just that. We believe increasing the value of our co-products offers the best opportunity to increase the efficiency and profitability of our plants.

SLIDE #4

Corn fiber, better known as corn gluten feed, is currently produced by all corn wet mills. It is one of our highest volume and lowest value co-products. Since the fiber is already present in the facility, it provides a unique opportunity to gain experience with biomass conversion technologies while providing a return to our investors.

SLIDE #5

That is why Williams is interested in biomass to ethanol. Now I'm going to talk a little about what we are doing to help make this technology commercially viable in the near future. The projects I'm about to discuss are Aworks in progress and are often changing as new information is developed. They contain propriety information and incomplete information at this time. Therefore, I will be presenting a general outline of the work without a lot of detail. All material is shown with the permission of the researchers involved.

SLIDES #6-8

The first project is a cooperative effort between Purdue University's Laboratory of Renewable Resources Engineering, the U.S.D.A., the D.O.E. and Williams. Dr. Michael Ladisch has worked for several years on the pretreatment of cellulosic materials including corn fiber. Dr. Rod Bothast's fermentation group at NCAUR is working on efficient fermentation of the pretreated material. The goal is to install a demonstration size pretreatment unit in Williams-Pekin Ethanol Facility to obtain scale up data and optimize the processes. Next, hydrolysis and fermentation units would be installed and data from the entire system would be used to design and build a full-scale system. We are currently in the process of scheduling large-scale equipment trials at manufacturers facilities to verify laboratory results.

SLIDES #9-11

We are participating in a project with the University of Chicago to develop a novel low cost cellulase enzyme. D.O.E. is also providing funds for this project through the Consortium for Plant Biotechnology Research.

The project involves producing the enzyme in a protected area in the plant. Dr. Lamppa's lab is the first to characterize the enzyme of the chloroplast that is responsible for the proteolytic processing of proteins that are imported from the cytosol.

SLIDES #12-16

The next project is a relatively new cooperative effort involving Oklahoma State University, The University of Oklahoma, and Williams. The U.S.D.A. is also providing funds for this work. This project takes a more comprehensive approach to biomass conversion including feedstock harvesting economics, and an unusual approach to the conversion problem.

That is a summary of what Williams is doing in the biomass to ethanol area. I would like to repeat that we believe continued improvements in both corn and biomass technologies are important for the continued growth of our industry.

WHY BIOMASS ?

- Limited supply of corn available
- Geographic advantages
- New technologies may reduce costs
- Environmental advantages
- Improving the bottom line

IMPROVING THE ENVIRONMENT

- Biomass to ethanol allows for increased volumes to be produced anywhere in the country resulting in further improvements in air quality.
- Many potential biomass feedstocks are waste products today.

INCREASING CO-PRODUCT VALUE

- A primary strategy to reduce ethanol cost/gal. and allow survival without tax incentives.
- Fiber to ethanol is one opportunity to increase the value of this co-product.
- Converting %30 of the fiber increases value from $.03/lb. to about $.08/lb.

CORN FIBER

- In a wet mill, approximately 12 lbs. of fiber is produced per bushel of corn processed.
- There is 250,000 tons/yr. of fiber available in a 100,000,000 gal./yr. ethanol plant.
- The fiber is already in the plant, ready for processing.

Williams

OUR VISION

- Fiber conversion is a convenient way to get experience with biomass technologies and increase revenues.
- Once experience with, and confidence in the technology is achieved, expansion of the feedstock will be easier to accomplish.

Williams

PURDUE

U.S.D.A

D.O.E

PRETREATMENT OF CORN FIBER FOR CONVERSION TO ETHANOL

OBJECTIVES

- INSTALL DEMONSTRATION SIZE PRETREATMENT UNIT IN WILLIAMS' PEKIN ETHANOL FACILITY
- OBTAIN DATA TO DESIGN FULL SCALE SYSTEM FOR CORN FIBER and/or CORN STOVER.

SUMMARY OF RESULTS

- Laboratory results indicate that conversion of fiber to ethanol can be economically attractive - <$.90/gal.
- The process can be integrated into an existing wet mill facility.
- The economic conversion of corn stover depends largely on the costs of delivery and value of the residual material.

UNIVERSITY of CHICAGO

D.O.E.

(thru C.P.B.R.)

ACCUMULATION OF PRODUCTS WITHIN THE PLASTID FOR BIOMASS CONVERSION:

TEST SYSTEM WITH CELLULASE

“The idea is to sequester the enzyme within the chloroplast where it is ‘hidden’, if you will, from its normal substrates, with the goal of eventually releasing an active form for cellulose degradation.”

The key is for the cellulase to be specifically targeted to the chloroplast.

- Targeting signal must be attached.
- Targeting signal must subsequently be removed to release an active enzyme.
- Dr. Lamppa's lab was first to characterize this key enzyme.

A HOLISTIC SYSTEM FOR CONVERTING BIOMASS TO ETHANOL

Oklahoma State University

University of Oklahoma

USDA

1. Infrastructure

- Determine quality of existing feedstock - wheat straw, switch grass, corn fiber, etc.
- Analyze existing and new unique systems for harvesting, transporting, and processing.
- Evaluate transportation limitations and alternatives.

2a. Gasification for Energy

- Evaluate techniques for gasification of biomass.
- Design and construct a laboratory/pilot-scale gasifier.
- Evaluate quality of syngas based on operating parameters and feedstock quality.

2b. Ethanol Production

- Evaluate existing processes for bioconversion of biomass to ethanol.
- Enhance existing processes and/or new novel concepts.
- Demonstrate in a pilot scale operation.

3. Design of Commercial Plant

- Develop a conceptual design.
- Conduct an economic evaluation.
- Conduct an environmental impact assessment.